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Competition and its effects on cooperation – an experimental test

Abstract

This paper inquires experimentally whether competition has any impact on the individual disposition to contribute voluntarily to the provision of a public good. Participants perform a task and are remunerated according to two schemes, a non-competitive and a competitive one, then they play a standard public goods game. In the first scheme participants earn a flat remuneration, in the latter they are ranked according to their performance and remunerated consequently. Information about ranking and income before the game is played vary across three different treatments from no information, to information only about income, to full information about ranking and income. We find that competition per se does not affect the amount of contribution, and that there is a clear and strong negative income effect. Also, and in line with other studies, it emerges that the time spent to choose how much to contribute is negatively correlated with the decision of cooperating fully, suggesting that cooperation is more instinctive than non-cooperation. However, the main result is that information plays a crucial role: full information about the relative performance in the competitive environment enhances the cooperation, while partial information reduces it. This result is robust and the effects are large. We suggest a couple of tentative explanations, but further research is required.

Keywords: competition; cooperation; public goods; experiments
JEL Classification: C91; D03; H41

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1 Introduction

The basis of this paper is the interest for the possible effects that a competitive environment may have on social interactions. On one hand the reason for this interest rests on the consideration that "markets and other economic institutions do more than allocate goods and services: they also influence the evolution of values, tastes and personalities" (Bowles 1998, page 75), so that "social preferences and tastes may not be independent of the institutional environment" (Brandts et al 2009, page 1158); on the other, it stems from the view that the hypothesis of selfishness as the sole determinant of human behaviour in economic activity is a reductive extension of behaviour in competitive markets to all aspects of economic interaction (for a similar point of view see for instance Fehr and Schmidt 2000).

Although the issue of how economic institutions - like markets - affect social preferences has been discussed broadly in the literature[1], few studies have analysed experimentally the effect of specific aspects usually associated with markets – like competition - on the disposition to cooperate. Brandts et al. (2009) underline the importance that competition may have for subjective well-being and social attitude by studying the effects of competitive rivalry on the disposition towards others in a social dilemma game without complete contracts. They find that rivalry increases neither efficiency nor the income of those on the short side of the exchange relation; besides, it has a negative effect on the subjective well-being of those on the long side, and increases the well-being of those on the short side, therefore generating inequalities. More importantly, in analysing the derived consequences rivalry may have on well-being, they conclude that interacting under rivalry impacts negatively on people's behavioural disposition towards others and, in particular, towards those encountered in interaction, and whom can be met again in the future, by decreasing "subsequent willingness to help" and potentially leading to the "obstruction of future cooperation" and "a deterioration of the social relations between interaction partners". Significantly, they note that these effects cannot be explained only by differences in earnings due to interaction, but "are strongly related to experienced emotions" (page 1166).

Carpenter (2005) conducts an experiment to measure the effects of economic institutions on people's social preferences, with the intent to assess whether and how aspects traditionally associated with markets, in particular anonymity and competition, affects individuals' preferences for other people's well-being. Results show that reducing anonymity makes people "more social", as it reduces people's ability to engage in opportunist acts, and more importantly, that market competition "erodes social preferences", not only because it encourages opportunistic behaviour, thus "creating a less friendly atmosphere", but also because the market institution itself - through a sort of framing effect - "decreases the other-regardingness" of participants (page 3).

A negative effect of competition on the propensity to cooperate has also been found by Canegallo et al. (2008), who study subjects' contribution to a public good in three different economic environments characterized by different degrees of competition.

Similar experimental findings are discussed in Hoffman et al (1994), who examine the effect of the framing of interactions as markets on ultimatum bargaining outcomes, and find that when interaction is framed as a market interaction the distribution of the surplus is significantly affected (sellers offer much less of the surplus to buyers). Markets appear to stimulate more egoistic behaviour, which also seems to suggest a deterioration of social preferences in markets.

[1] For a discussion of theories concerning the role of markets in the formation of social preferences see for instance Carpenter (2005).

Schotter, Weiss and Zapater (1996) show that the introduction of competition reduces offers in the ultimatum game, providing evidence that competition seems to make participants more selfish.

Our experiment aims at inquiring the effects of two aspects of competition. First, whether competition has any effect on the willingness to participate to the voluntary provision of a public good. Second, whether the results of this competition in terms of both position in the ranking and wage premiums affect one's contribution to the public good.

In the following section the experimental design and procedure are described; in sections 3 we introduce the experimental methodology; in sections 4 and 5 the descriptive and econometric results are given, and section 6 concludes.

2. Experimental design and procedure

We designed an experiment with two steps and four treatments, and we implemented a repeated public goods game (PGG) with re-matching, so that each subject always played each round against subjects who were all different from those of the other rounds. A total of 160 subjects participated in the experiment, 40 for each treatment. All of them were students of the School of Economics of the University of Torino (Italy). We recruited them by advertising for the experiment on the webpage of the School, and they enrolled following an online procedure. No show up fee was given. Each experimental session involved 20 participants. Full anonymity was granted during and after the experiment.

The experiment was made of two parts. In the first the participants were asked to perform an administrative-type task consisting in recopying in a form on the screen of their pc the enrolment numbers, the names and the scores of fictitious students, whose names were created by choosing at random a string of letters. A quadruplet made of enrolment number, surname, name and mark entered correctly in the form made a completed unit of the task. In the case of mistake, the program alerted the participant and did not allow to continue before the mistake had been corrected.

The first difference between the treatments concerns the remuneration of this part of the experiment. We implemented two schemes, a non-competitive and a competitive one; the first provides the baseline for assessing the effect of competition. In the non-competitive scheme the subjects got a remuneration of 8.5€ if they recopied correctly 40 quadruplets in 30 minutes and 4 € otherwise, i.e. if they did not finish the task. The program announced the end of this part of the experiment either after that the 40th quadruplets had been entered, or after 30 minutes[2]; instead, in the competitive scheme the number of lines to be recopied was not limited, and at the end of the task, i.e. after 30 minutes, the subjects were ranked according to their performance, and the payments were differentiated. The players falling in the best group of 5 obtained 15€, those in the second best group 10€, those in the third 6€ and those in the last 3€. The payment in the baseline treatment (i.e. 8.5€) corresponds to the expected payment under the competitive treatment[3]. The players recopied on average 80.08 quadruplets under the competitive scheme, i.e. the double of the goal assigned in the non-competitive framework. This proves that the requirement under the non-competitive treatment was easy to accomplish and arguably did not entail competition among the subjects. Before starting the session, the experimenters informed the subjects about the rules. In particular the people in the competitive environment knew that they would have been divided in four groups according to their performance and that the

[2] It never occurred that a subject did not complete the task in the 30 minutes allocated.

[3] This allows to compare average performances and average choices across the treatments.

payments were to be scaled across the groups, with the highest for the best performing group. Instead, the information about the amounts paid to each group and about the actual ranking was provided in different ways across the treatments, as we will describe in detail below.

After performing the described task, the subjects played five rounds of a classical PGG in groups of four anonymous individuals. In order to maximise the number of observations, we re-matched the players after each round, following two rules. The first was *random matching* (see Andreoni, 1988 and Botelho et al., 2009), which means that at each round the players were matched with three others who were not members of the same group neither in the previous nor in the subsequent rounds[4]. In other words, each player faced three new opponents in each round. The second rule, relevant for competitive treatments, constrained this re-matching procedure to form the groups so as to always include one player from each of the quartiles in which the players were ranked after the initial task. This procedure was envisaged to avoid any possible effect due to the average amount gained in the first part of the experiment. Assume that contributions increase with initial income. If three subjects with low initial income and a subject with high initial income compose a group, the latter will possibly contribute more than the former ones in the first round. At the end of the round, when the high-income individual looks at the sum of all the contributions, s/he could get disappointed by the fact that the other three members contributed less than her/him, and this could affect her/his subsequent behaviour (see Cherry et al., 2005 and Buckley and Croson, 2006). The composition of the groups described above excludes this effect. However, given the capacity of the lab (20 seats), the described procedure allowed for a maximum of five rounds of the PGG.

The players who worked in the competitive environment played the PGG under three different treatments. The difference concerned the information about their position in the ranking and the income they received in the first part. In the first treatment neither the position in the ranking nor the remuneration from the first part was disclosed before the PGG; this information was given them only at the very end of the experiment, i.e. after playing the PGG. The second treatment entailed the disclosure of the information about the income obtained in the first part, but not of the ranking, before playing the PGG; the subjects knew their position in the ranking *after* the PGG. In the third treatment the complete information about placement and income from the first part was disclosed before the PGG. To sum up, the participants played the PGG either 1) knowing neither their ranking nor their income, 2) knowing only the income, but not the ranking, and 3) knowing both. The difference between these three treatments aims at disentangling the effects of competition. The comparison of the blind treatment with the baseline treatment (where there was no competition) isolates the effect of working under competitive pressure, clean from the effect of income and that of pride (or frustration) arising from knowing the position in the rank. The comparison between the blind treatment and that with partial information aims at identifying the effect of the initial endowment on the contributions to the PGG. Finally, the treatment with full information isolates the effect of knowing the position in the ranking thanks to the comparison between this treatment and the others.

At the beginning of each of the five rounds of the PGG the participants received an endowment of 60 experimental coins, each worthy 0.01€. The subjects then had to decide whether to keep them for themselves or to allocate all or part of them to a common fund, knowing that the total amount contributed would have been doubled and then redistributed in equal shares among the members of the group at the end of each round. The coins kept by the subject remained as his/her earning. The subjects also knew that they would have always been matched with strangers at the beginning of each round. Between one round and the following

[4] Of course, all players were informed about this.

the subjects viewed the total amount contributed and their gain in that round. At the end of the PGG the total payoff (the sum of what was earned in each of the five rounds of the PGG plus the gain of the first part of the experiment) was displayed.

As we know, in this kind of PGG the unique subgame perfect equilibrium predicts always to contribute nothing to the common fund (complete free-riding), while the Pareto-efficient solution (full cooperation) predicts allocation to the fund of the whole endowment.

At the beginning of each session the subjects were sat at 20 different isolated computer terminals, so that no communication was possible. The instructions appeared sequentially on each participant's computer screen and would proceed to the following page only when all the participants had clicked on the 'Continue' button on the screen, while they were read aloud by an experimenter at the same pace. When the instructions on the first part of the experiment were over, the time for the completion of the task started running. The list with the data to be copied as well as the rows with the empty fields appeared sequentially on each participant's screen. In the treatments with competition the countdown in seconds of the time remaining was displayed on the top right hand-side of the screen. When the time was over the information about the ranking and/or income was given according to the treatment. Then, the second part of the experiment started. The PGG was illustrated to the subjects, both on the screen and by an experimenter. It was made clear that: the game would have been played in groups of 4 participants unknown to each other and that the composition of the group would have changed at each round, with no re-encounters; that all the initial sum would be kept as earnings in case no coin was allocated to the common fund and that the total earnings in case all participants allocated all the sum to the fund would be twice the initial endowment; and that no amount could be transferred from one round to the following one.

After the description a written summary of the instructions was distributed to the participants and this part of the experiment started. In each repetition the subjects faced a screen with an empty box where they had to enter the amount of coins they wanted to allocate to the common fund. After each subject had taken the decision or the time allocated had passed, a new screen for a new round appeared. In every repetition each subject could see summarized in a table the total amount of the common fund, her/his earnings for that round, the amount of coins kept and the division of the common fund and her/his total profit up to that round. At the end of the 5 rounds, the total earnings of the experiment (first and second part) appeared on the screen. Once the experiment was over, the subjects were asked to fill in a questionnaire which appeared on the screen, then they were asked to leave the room and come back individually to fill in their receipts and be paid in full anonymity.

3. Experimental strategy and empirical methodology

Two figures were of interest: the contribution to the PGG and the share of extreme behaviours, that is *free riding* (i.e. contributing 0 to the PGG) and *full cooperation* (i.e. contributing the entire endowment of 60 experimental coins). At each round, the contribution to the PGG is bounded between 0 and 60. We therefore treat this variable as a truncated continuous variable, and analyse the effects of the treatments on it with tobit regressions. We specify three different models to check whether the effects of the treatments are robust to different specifications. In particular, in the first we include: the dummies for the different treatments, the time spent by the subject to decide how much to contribute, the time spent in looking at the results of the previous round, a variable that captures the round, and two one-period-lagged dummies for the extreme behaviours (free riding and full contribution). In the second specification we replace these extreme choices with the value of the fund (i.e. the sum of

all the four contributions) and the average contributions of the other three members of the group[5]. Both these last controls are present lagged by one and two rounds to capture their persistence on the individual choices[6]. The extreme choices are instead considered *per se*: we constructed dummy variables for free-riding or contributing the full endowment at each round. In this case we analyse the data using probit regressions.

Whereas we designed the experiment in order to render the observations independent of each other at every round, gains and the others' contributions in a round may affect the choice in the subsequent ones. Therefore, we run panel regressions and, for each individual, we control for both the lagged value of the total fund and of the average contributions of the other three members of the group. In this way we capture the "learning" effect, i.e. the effect that playing in a group of co-operators (non-co-operators) in round t-1 (and t-2 in a second estimated model) may have on one's decisions in round t. We capture the well-known decreasing trend of contributions to the PGG (Laury and Holt, 2000 and Lotito et al., in press) controlling for the round. Moreover we control for the time spent in choosing the contribution and for the time spent in looking at the results in the previous round. There is indeed evidence that these times proxy for the subject's degree of instinctiveness used in the decisional process (Rubinstein 2007, 2013; Piovesan and Wengström 2009 and Lotito et al. 2013). This will therefore clean the results from the "instinctiveness" component. We also control for the participant's gender (1 if male, 0 if female), and – in one of the three estimated models – for a couple of dummies that capture whether the subject had fully cooperated (i.e. contributed 60 experimental coins) or free-rode in the previous round. This helps to clean the results from the possibility that someone had a pre-conceived strategy of pure contribution or pure free-riding. We control also for the voluntary social activities conducted by the subjects (as detected from the questionnaire), in order to capture the possible effect of pro-social attitudes. In the econometric analysis presented below we do not control for the income gained in the first part of the experiment, as we have introduced it in several estimations, but it had never shown any statistically significant effect[7].

We present also an analysis of the response times to understand the degree of instinctiveness behind the subjects' decisions (Rubinstein 2007 and 2013) in order to assess whether the presence of competition and the information about one's position in the competitive ranking render the decision more or less instinctive. The reason here may be that people whose labour income is high (low) may think less (more) about how much to contribute to the production of a PGG.

4. Results: descriptive and graphical analysis

Table 1 presents the descriptive statistics for the variables used in the subsequent analyses. We may observe a certain variability between the contributions in the different treatments.

Most noticeable, full information about both the ranking and the income from the first part enhances considerably the contributions to the PGG with respect to all other cases. The

[5] This is calculated as follows: $c_{-i,j,t} = \frac{1}{3}(F_{j,t} - c_{i,j,t})$ where $c_{-i,j,t}$ is the average contribution to the PGG of the subjects other than subject "i" who belong to group j at time t; $F_{j,t}$ is the amount of the fund of group j at time t, and $c_{i,j,t}$ is the contribution of subject i who belongs to group j at time t.

[6] The dummies for extreme behaviours and the lagged value $c_{-i,j,t}$ are not introduced in the same model, to minimise multicollinearity.

[7] Income is not statistically significant even in the treatment where only the wage gained in the first part of the experiment is disclosed before the PGG.

performance in the three treatments with competition is statistically the same (See Table 2), what suggests that the subjects involved in these treatments had statistically the same ability, and therefore the differences on the other outcomes cannot be attributed to heterogeneity in abilities. In table 2 we observe that male subjects recopied correctly more quadruplets that their female peers, what might reflect the fact that competition has different effects on the two genders, with males more responsive than females to competition (Niederle and Vesterlud, 2007 and Migheli, 2015). This might affect the results: if males are more competitive and they work harder than females, then we will end with more males than females receiving a high income from performing the task. Indeed there is an average difference of 0.89€ in the sub-sample of subjects who recopied the quadruplets in a competitive setting. This difference is statistically significant (at 1% level), but is small both in value and in relative terms (it amounts to 10.5% of the average income from the first part). In any case, as our experimental subjects are mixed by gender, this does not affect, on average, our results. Finally, we can notice that the time needed by the subjects to choose how much to contribute to the PGG is decreasing with the level of information disclosed before the PGG. We will discuss this result later.

Figure 1 presents the average contributions per treatment on a vertical line for the full game (i.e. the means are calculated by treatment and over all the five rounds of the game)[8]. Figure 2 presents the densities of the contributions in the four treatments. We can observe that in the baseline and in the treatments with no or only partial information the density of free-riders and of subjects with low contributions is much larger than in the treatment with full information. In addition the share of contributions equal to the whole endowment (60 experimental coins) is much higher in this last treatment than in all the others.

Figure 3 shows the same variable as Figure 1, by each round. We can observe some stability in the relative distances between the average contributions by treatment. In addition, we also observe that in the treatment with full information the level of the contributions remains high, whereas it tends to decline in the other treatments. The central line of the graphs represents the average contribution on the full sample: it visibly decreases, while the average contribution of the subjects in the full-information treatment stably remains above 40 experimental coins[9]. We also observe that the contributions in the baseline treatment are very close to the full-sample mean on average. Tests on these differences reveal that in the full-information setting the average contributions are not statistically different over the five rounds. In the other treatments, the decrease between the first and the fifth round is always statistically significant at 5% or even at 1%. In addition, in the baseline treatment, the decrease of the contribution with respect to the first round is statistically significant since the fourth round (38.95 coins in the first against 29.62 in the fourth – p-value = 0.034 – and 29.30 in the fifth – p-value[10] = 0.029). In the competitive treatment with no information about the ranking or about the income, the decrease with respect to the first round is statistically significant since the third round (39.57 coins in the first, against 31.02 in the third – p-value = 0.041 – 27.05 in the fourth – p-value = 0.001 – and 19.30 in the fifth – p-value < 0.001). In the setting with partial information, the decrease with respect to the first round becomes statistically significant since the third round (from 35.35 coins in the first to 26.95 coins in the third – p-value = 0.057 – to 19.32 in the fourth – p-value = 0.0001 – to 20.20 in the fifth – p-value = 0.002). All this is important. It suggests that competition disrupts cooperation when there is full or partial ignorance, while it enhances both the level of the contribution and the maintenance of a high level over time (rounds) when there is full knowledge. Also, the data show that partial ignorance (i.e. when only the information on the

[8] The horizontal line identifies the overall average.

[9] Note that the scale on the vertical axis in the figure (the average contribution) differs slightly for the different rounds.

[10] Here and below the p-value refers to the statistical significance of the difference between the average contribution in round t (for t = 3, 4, 5) and the average contribution in round 1.

income earned is disclosed) hinders cooperation more than full ignorance. The relevance of knowledge was unexpected; data do not provide an indication about its cause. We will suggest a possible explanation in the last section.

Table 3 compares the average contributions to the PGG by treatment and assesses whether they are, on average, statistically different from each other. We can observe that in the treatment with full information the high average contribution is statistically different from those in all the other treatments, confirming the conclusions suggested by the graphical analysis. Also the low level displayed in the treatment with partial information is always statistically different from the others, suggesting that the effect of the income gained by performing the task negatively affects the cooperation in the provision of a PGG. Surprisingly the pure effect of competition (assessed by comparing the baseline treatment with that where no information is disclosed before the PGG) is statistically null: the players who were subjected to the competitive pressure display the same level of contribution as the players who performed the task of the first part in absence of any competitive incentive. From this tables we can infer that 1) competition *per se* when the results from it are not known does not affect the individual decisions of how much to contribute to the provision of a PGG (i.e. competition does not affect the individual levels of cooperation); 2) there is a clear and strong negative income effect; 3) knowing the own relative ability with respect to the group enhances cooperation in a way that overwhelms the negative effect of income and leads the subjects to levels of cooperation higher than in the baseline case of no competition. Table 4 completes this picture reporting the percentage of times in which a subject made an extreme choice (either free-riding or contributing the entire initial endowment). These percentages are calculated on the total number of choices made (this renders the number of observations equal to 800: 160 subjects multiplied by the 5 rounds). The subjects free-rode much less and contributed the full amount much more frequently in the treatment with full information than in the other treatments. In particular, the effect is much stronger for the cases in which the subjects contributed the full amount. Indeed, the share of free-riding decisions is similar in the baseline treatment and in the full-information one, with no significant difference, while the difference is very strong when in the case of full cooperation. Apparently, the effect of knowing the position in the ranking is more effective in enhancing cooperation than in discouraging free-riding.

5. Results: econometric analysis

Table 5 reports the coefficients of tobit regressions for three different specifications. The figures confirm what has already been suggested by the previous analysis. The baseline treatment is taken as reference; this implies that the coefficients for the three treatments introduced in the regressions are to be interpreted as effects relative to the baseline. The contributions under full information are always significantly larger than those in the baseline, and people contributed significantly less in the partial-information treatment than in the baseline. Moreover, a simple t-test highlights that the coefficients for the full-information treatment are statistically different from the coefficient for the partial-information treatment. This also confirms the previous results. People playing the PGG under the no-information treatment contribute less than people playing the baseline, but the difference is not statistically robust to different specifications of the model. The figures in the table suggest also other interesting results. First, in spite of the matching procedure that always generates groups of strangers (i.e. of people who had never played in the same group in any of the previous rounds), the contributions are strongly path-dependent. The coefficients for the lagged values of the total fund (i.e. the sum of the contributions of the four members of the group a subject is part of) and the coefficients for the lagged values of the others' average contribution are statistically very significant. In particular, the value of the fund at times t-2 (L2) and t-1 (L1) affect the individual

contribution at time t positively, while the average amount of the others' contribution has the opposite (i.e. negative) effect. Moreover the magnitude of the coefficients is almost the same, suggesting that the subject discount the past at a very low rate.

The inclusion of these variables in the regression decreases the coefficients for the partial and the full-information dummies and the associated levels of significance. Arguably, this is a reflex of the persistence over time of the effect of the past experience on the present decision. This suggests that, while the observations in our sample are independent of each other because of the way in which the groups are formed at each round, the individuals anyway internalise the behaviour of the others in the previous rounds, and they discount these behaviours at a very low rate (the coefficients are very close to each other over time). Last but not least, the dummy that captures whether the distance from one's contribution and the average contribution at t-1 is positive has a positive coefficient. This suggests that people who tend to be cooperative in a round remain more cooperative than the average in the subsequent rounds. Gender does not appear to be significantly related to the level of contributions.

Besides, it can be noted that the amount of time people take to decide how much to contribute is positively and significantly related to the level of the contribution, while the longer they take to see the results from the previous round, the less they contribute.

Table 6 presents the results of the panel probit estimates for the extreme behaviours. These are defined as perfect free-riding (i.e. contributing 0 experimental coins in a round) and as complete cooperation (i.e. contributing 60 experimental coins, the whole endowment, at each round). The figures in the table confirm what the other analyses have already highlighted. The treatments have no effect on the probability of free-riding: this behaviour is distributed more or less homogeneously across treatments, although when full information is provided, the share of free riding episodes on the total number of decisions is slightly lower than in the other cases (but this difference is not statistically significant). Only the average contribution of the other players in round t-1 seems to slightly decrease the probability of free-riding in round t, but this result is not robust to different specifications (compare columns 1 and 2 of Table 6). The treatment is instead effective in promoting cooperation: in the setting with full information, the probability of contributing all the 60 experimental coins in a round is between 73 and 83 percent higher than in the baseline treatment. This is an impressive figure; we will discuss it in the following section, while there is no significant difference between this last and the other two treatments that do not entail full information. Also, the total value of the fund in round t-1 increases the probability of contributing the full endowment in round t, while the opposite happens for the average contribution of the others. This is in line with the results presented in Table 5. Apparently, the subjects respond positively to the aggregated level of contributions, but tend to try to benefit from the others' high contributions. This appears as a contradiction; but suggests two reflections. First, at the end of each round the subjects see the total value of the fund, but they do not see the others' average contribution nor the others' individual contributions. Since we do not know whether they mentally calculate the others' average contribution we could assess that the marginal effect relative to the total value of the fund is more meaningful than the marginal effect of the other variable. Second, since the total value of the fund includes the subject's contribution, and given the signs of the two variables we are considering here, we could conclude that the two opposite signs indicate that the subject is, in some way, influenced by his past choices. This may entail two interpretations: 1) there is some degree of constancy in the subject's behaviour, so that people who start contributing large stakes continue doing so; 2) the individual really responds to the total value of the fund by increasing one's own level of cooperation, but s/he does not disentangle her/his own from the others' contributions and his/her behaviour is unconsciously driven by her/his past decisions.

Interestingly, the time spent by a subject in looking at the results increases the probability of free-riding (column 1), and decreases that of contributing the whole endowment (column 3). However, these results are not robust to different specifications. The time spent to choose how much to contribute is not relevant in the case of free-riding, but is negatively correlated with the decision of cooperating fully. This suggests that cooperation entails a higher degree of instinctiveness than non-cooperative or intermediate behaviours. This confirms what already observed by Lotito et al. (2013).

5. Conclusions

In the last section we already reported some ancillary results. Here we discuss the main ones. Our experiment aimed at assessing the effect of competition on cooperation. The hypothesis was that exposition to competition reduces the propensity to cooperate, arguably due to the enhancement of a selfish mood propitiated by the competition. We found a mixed support for this hypothesis. In absence of information about the effect of the competition the propensity to cooperate resulted unaffected (table 5, line 1). Note that this result is not conclusive: it is possible that the competition was too feeble to actually induce a selfish mood, or that the "they came to play" effect (see Carpenter *et al.*, 2006), prevailed. Instead, we found that competition has an effect if information that accompanies it is assessed. Partial information reduces the propensity to cooperate (table 5, line 2), but *full* information strongly enhances it (table 5, line 3). We cannot provide any explanation; we can only suggest some. The first has to do with the notion of *overall security*[11]. A person feels more secure the more s/he knows all the relevant features of the environment that surrounds her/him; and a secure person, arguably, is more prone to help. In our setting the full knowledge of one's own position in the game produces a feeling of security, while a partial knowledge adds an element of uncertainty to the environment, and hence reduces security, and a total absence of information de-emphasizes the security concern. However, the study of security as such is in its infancy (see Garrone and Ortona 2013, also for a discussion of the meaning of the notion), hence what has been stated above is highly speculative. The second possible interpretation is that people who are shown that their remuneration is fair compared to that of their competitors, as it reflects their relative performance, are more willing to contribute to the common good. This because if the payment for a work is perceived as fair, negative sentiments such as envy and resentment are minimised. This could be an extension of the idea of conditional cooperation (see Fischbacher et al., 2001). Indeed, people evaluate fairness not only looking at the results of some behaviour, but also at the intentions behind that behaviour (Falk and Fischbacher, 2006). In this sense, the subjects who are presented both their position in the ranking and their payment, may feel that their remunerations are intentionally fair, and therefore they show a high level of cooperation (conditional on how they have been previously treated). Note that the two explanations are not alternative, and that both require further evidence to be assessed. However, what the present paper mostly suggests for further research is to analyze the role of information in promoting or harnessing spontaneous cooperation.

[11] Garrone and Ortona (2013) found that overall security, as self-assessed following the economics of happiness approach, strongly correlates with several relational and economic items. The definition adopted by the authors (p.275) is "the feeling that a weighted average of what is important for life is not bound to worsen".

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Tables

Table 1. Descriptive statistics: average values and their standard deviations (in brackets)	
Average contribution (experimental coins)	
Full sample	32.94
	(23.33)
Baseline treatment	33.31
	(22.58)
Competition with full ignorance	30.31
	(22.76)
Competition with partial information (wage only)	26.41
	(23.08)
Competition with full information	41.70
	(22.31)
Performance in the task (average number of triplets correctly recopied by the subjects)	
Full sample	70.05
	(23.85)
Baseline treatment	39.95
	(0.33)
Competition with full ignorance	80.22
	(19.26)
Competition with partial information (wage only)	81.12
	(16.38)
Competition with full information	78.89
	(20.69)
Individual characteristics	
Subjects who volunteer (%)	15.62
	(36.33)
Males (%)	56.50
	(49.61)
Average choice times (in seconds)	
Full sample	27.62
	(26.60)
Baseline treatment	29.40
	(27.52)
Competition with full ignorance	33.00
	(29.32)
Competition with partial information (wage only)	24.98
	(22.93)
Competition with full information	23.49
	(25.42)
Percentage of free-riding episodes[1]	16.75
	(37.37)
Percentage of full co-operation episodes[1]	30.87
	(42.23)

1) Calculated on the total number of observations (number of subjects x rounds)

Table 2. Recopied quadruplets and treatments. OLS estimates (s.e. in brackets)	
Male	4.669
	(1.560)***
Competition with partial information (wage only)	0.643
	(1.187)
Competition with full information	-1.680
	(1.877)
Constant	77.657
	(1.578)***
Observations	160
R-squared	0.017
Root-MSE	18.73

Table 3. Average contributions per treatment compared by couples (standard errors in brackets)

	Average contribution	Significance with respect to treatment				Observations
		BL	IG	PI	FI	
Baseline	33.31 (1.596)		-	***	***	200
Competition with ignorance	30.31 (1.610)	-		*	***	200
Competition with partial information (wage only)	26.41 (1.632)	***	*		***	200
Competition with full information	41.70 (1.579)	***	***	***		200

Legenda: BL = baseline; IG = with ignorance; PI = with partial information (wage only); FI = with full information
Significance levels: *** 1%; ** 5%; * 10%; - not significant at conventional levels

Table 4. Extreme behaviours per treatment compared by couples of treatments (standard errors in brackets)

	% of free-riding episodes	Significance with respect to treatment				Observations
		BL	IG	PI	FI	
Baseline	16.00 (36.75)		-	*	-	200
Competition with ignorance	17.00 (36.66)	-		*	*	200
Competition with partial information (wage only)	22.00 (41.53)	*	*		***	200
Competition with full information	12.00 (32.58)	-	*	***		200
	% of full co-operation episodes	BL	IG	PI	FI	
Baseline	29.50 (3.23)		-	**	***	200
Competition with ignorance	24.50 (3.05)	-		-	***	200
Competition with partial information (wage only)	20.50 (2.86)	**	-		***	200
Competition with full information	49.00 (3.54)	***	***	***		200

Legenda: BL = baseline; IG = with ignorance; PI = with partial information (wage only); FI = with full information
Significance levels: *** 1%; ** 5%; * 10%; - not significant at conventional levels

Table 5. Tobit analysis of the individual contributions (measured in experimental coins) to the public good (standard errors in brackets)

VARIABLES	(1) Contribution	(2) Contribution	(3) Contribution
No information	-5.534	-6.648	-6.409
	(5.599)	(4.460)	(7.687)
Partial information (wage only)	-11.12**	-7.689*	-14.58*
	(5.633)	(4.632)	(7.698)
Full information	16.08***	8.852*	21.85***
	(5.901)	(4.608)	(7.967)
Round	-3.320***	-0.958	-5.824***
	(1.262)	(1.974)	(1.040)
Mean of the others' contributions (L1)		-1.706***	
		(0.262)	
Total contributions (L1)		0.605***	
		(0.0816)	
Mean of the others' contributions (L2)		-1.657***	
		(0.261)	
Total contributions (L2)		0.535***	
		(0.0828)	
Time to choose	0.199***	0.152**	0.200***
	(0.0640)	(0.0638)	(0.066)
Time to see results (L1)	-0.186*	-0.329***	
	(0.110)	(0.123)	
Full cooperation (L1)	21.95***		
	(4.833)		
Free riding (L1)	-13.94**		
	(6.456)		
Male			-5.739
			(5.477)
Difference from the average contribution (L1)			0.044
			(0.080)
Constant	37.29***	8.182	63.76***
	(9.524)	(14.17)	(7.407)
Observations	640	480	640
Number of subjects	160	160	160

Significance levels: *** p<0.01, ** p<0.05, * p<0.1

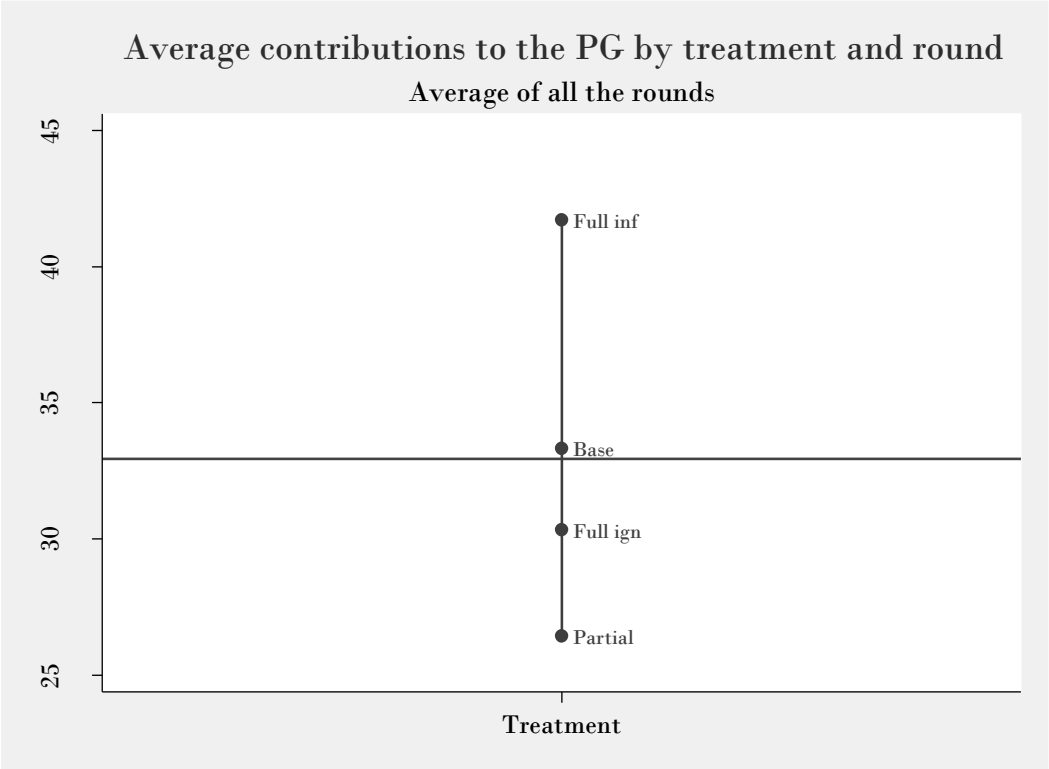
Table 6. Analysis of extreme contributions. Panel probit estimates (s.e. in brackets)

VARIABLES	(1) Free rider	(2) Free rider	(3) Cooperator	(4) Cooperator
Male	0.687**	0.742**	0.118	0.121
	(0.295)	(0.336)	(0.225)	(0.247)
With no information	-0.0837	-0.0215	-0.152	-0.194
	(0.407)	(0.460)	(0.323)	(0.352)
With partial information (only about wage)	0.189	0.356	-0.178	-0.248
	(0.392)	(0.452)	(0.323)	(0.354)
With full information	-0.358	-0.415	0.730**	0.827**
	(0.416)	(0.471)	(0.329)	(0.363)
Round		0.213**		-0.171**
		(0.0976)		(0.0795)
Total contributions (L1)	-0.00780*	-0.00295	0.0243***	0.0214***
	(0.00437)	(0.00518)	(0.00468)	(0.00514)
Average others' contribution (L1)	0.0162	0.00471	-0.0669***	-0.0597***
	(0.0144)	(0.0163)	(0.0152)	(0.0163)
Time to look at the results of the previous	0.0170**	0.00910	-0.0142**	-0.0101
	(0.00793)	(0.00901)	(0.00630)	(0.00682)
Time to make the choice	-0.00493	-0.00468	-0.0184***	-0.0190***
	(0.00443)	(0.00464)	(0.00431)	(0.00459)
Income from the initial task		0.0142		0.00481
		(0.0406)		(0.0312)
Volunteer (yes = 1)	-0.581		0.291	
	(0.435)		(0.307)	
Constant	-2.498***	-3.320***	-0.701	-0.304
	(0.813)	(0.951)	(0.631)	(0.720)
Observations	640	640	640	640
Number of subjects	160	160	160	160

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1. Average contributions to the PGG (experimental coins)



The figure presents the average contributions, in experimental coins (each worth 0.01€). The figures are the average of the contributions in all the five rounds of the PGG.

Full inf = treatment with competition and full information about income and ranking disclosed before playing the PGG

Base = baseline treatment

Full ign = treatment with competition and no information about income and ranking disclosed before playing the PGG

Partial = treatment with competition and information only about the income gained in the first part disclosed before playing the PGG

Figure 2. Densities of individual contributions to the PGG (experimental coins) per treatment over all the rounds.

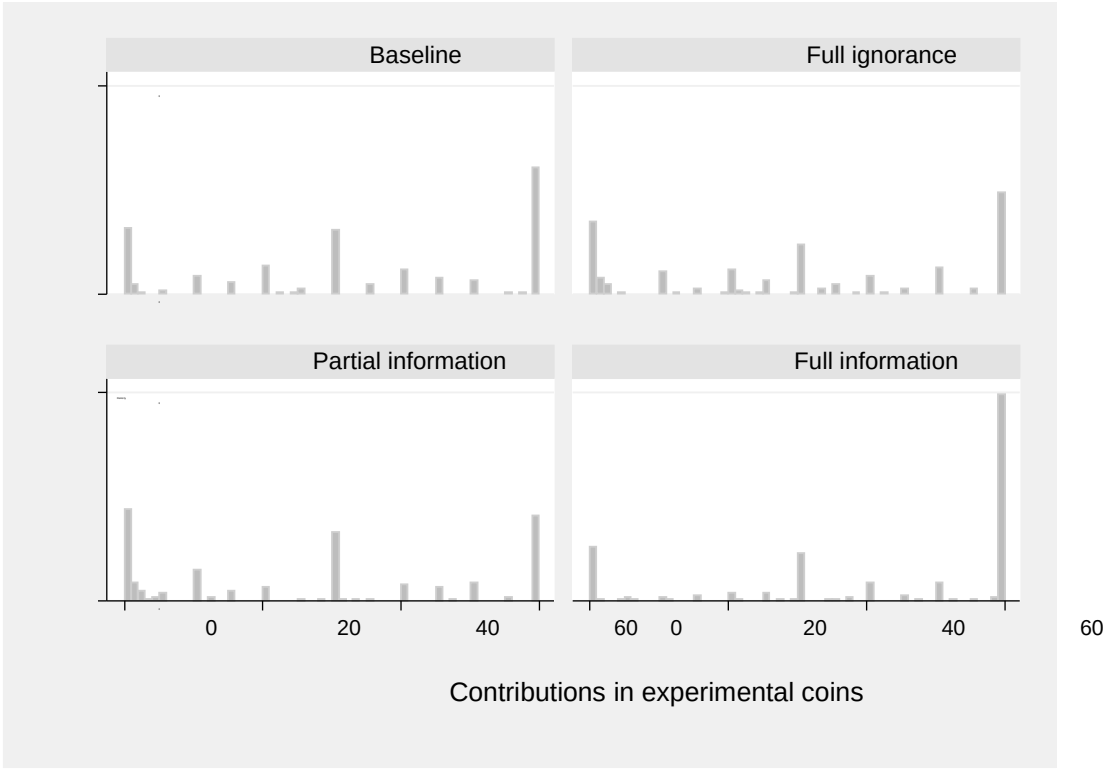
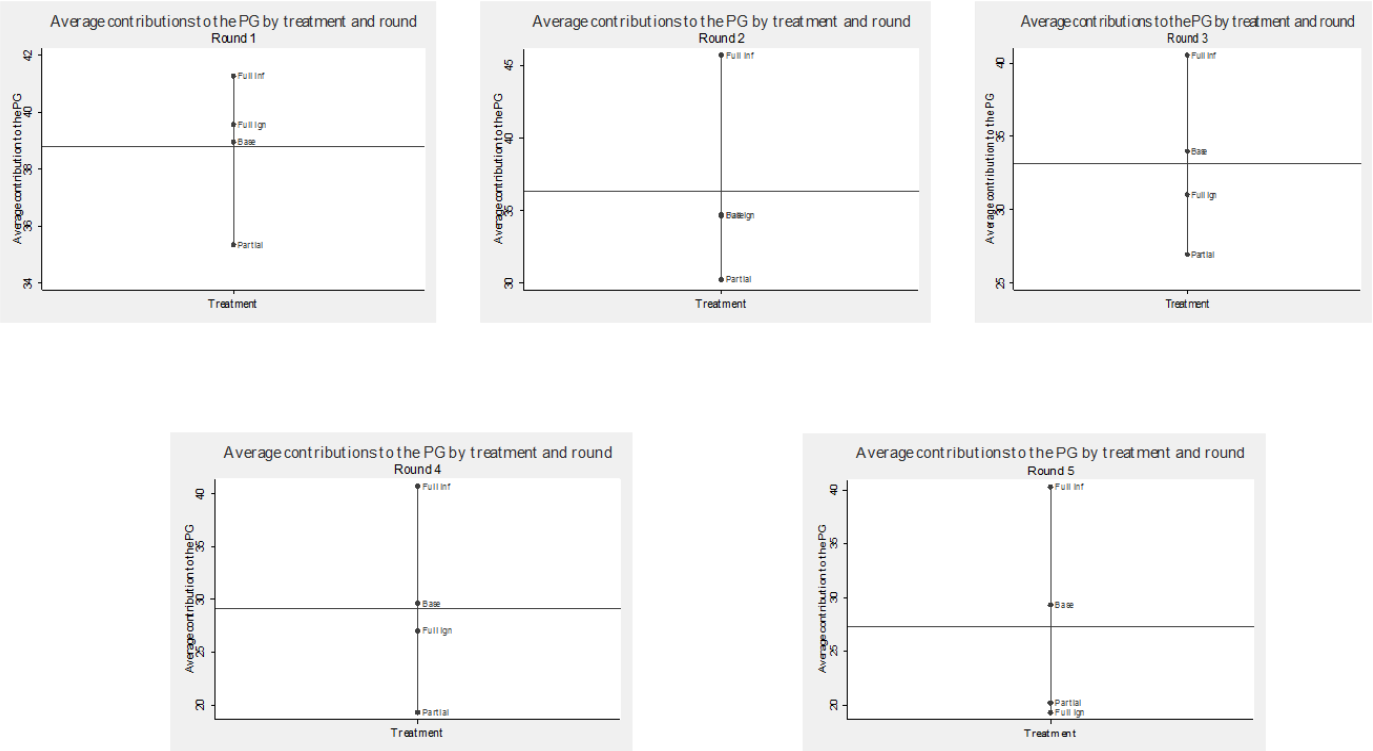


Figure 3. Average contributions to the PGG (experimental coins) by round



The figure presents the average contributions, in experimental coins (each worth 0.01€). The figures are the average of the contributions by round of the PGG.

Full inf = treatment with competition and full information about income and ranking disclosed before playing the PGG

Base = baseline treatment

Full ign = treatment with competition and no information about income and ranking disclosed before playing the PGG

Partial = treatment with competition and information only about the income gained in the first part disclosed before playing the PGG

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